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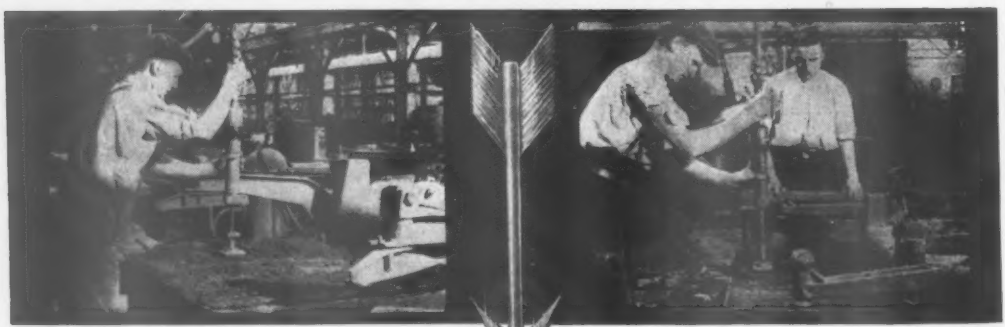

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FOUNDRY TRADE JOURNAL
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The Basic Cupola

It is of some moment that we are able to announce that at long last means have been found to line cupolas with basic refractory material, and, moreover, the process is in commercial operation. It is germane to note initially that this process has but little practical interest for the ordinary producers of grey cast iron, as the reduction in the silicon content would be so drastic as to render the material white, and heavy costs would be incurred in order to adjust the composition by the addition of ferro-silicon. So far the process looks attractive for manufacturers of cupola melted iron for malleable and steel making wherein the silicon contents are inherently low. From the slag analyses, given by Mr. E. G. Renshaw in his article, printed elsewhere in this issue, it would appear that the process brings about a considerable economy in metal melting losses. This statement is based on the low iron oxide content (in one case only of the order of 0.50 per cent.) in the slag, as against, say, 4.5 per cent. in normal practice. Yet it has not been established that a normal cupola, running with low FeO content in the slag, enjoys a lower metallic loss than one making high iron-oxide bearing slags. Much depends on the nature of the charge and the general conduct of the process. So far all that has been thoroughly proved is a very useful sulphur reduction. The next problem, which will necessitate much investigational work, is the reduction of the phosphorus content. We imagine this would be easier to attain if relegated to the realm of ladle metallurgy, as the blast—a fundamental of cupola practice—imposes a metallurgical barrier, extremely difficult of scaling. Still, by structural modifications to the cupola, ways and means may be found, now that the initial difficulties of the lining have been mastered. The process is obviously of interest to the makers of refined iron, as providing them with a method alternative to the use of soda ash. For true blast-furnace practice we are inclined to rule out any worthwhile development, as the soda-ash process has few, if any, drawbacks. The plant generally being situated in the open air, the fume problem does not arise. The details now made available will act as a stimulus to the rotary furnace interests to carry out experiments on similar lines. Once they have travelled as far as the cupola has progressed in this direction, they should be well placed to tackle dephosphorisation. Actually we would expect this reaction to be quicker and more thorough than in either the open-hearth or the basic-electric furnace, because of rotary motion. In reading the above, it might be assumed that sulphur and phosphorus are deleterious elements which must be eliminated from metallurgy. This is by no means true, and in discussing the potentialities arising from the possibilities of lining furnaces with basic material, we have in mind only those metallurgical processes which tradition dictates must be as low as possible in these two elements. The main significance of this development is the provision of a new type of apparatus in which to conduct metallurgical operations. It has already found a useful field and we do not doubt that its area is well capable of useful expansion.

The outlook for grey-iron castings as such for the post-war period does not seem too promising, due to the fact that new lighter metals will be available, says W. L. SEELBACH, the Forest City Foundries Company, Cleveland, in "Steel." Such metals have either had their strength increased or are entirely new developments. These lighter metals will be in much demand for many items that were made in cast iron prior to the war. However, it is believed there will always be a demand for grey-iron castings, even though new metals may replace grey iron in many applications.

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NOTES FROM THE BRANCHES

WEST YORKS BRANCH

The 1942-43 session was concluded by a visit, on May 15, to the works of Modern Foundries, Limited, at Halifax. By courtesy of the company the visitors were enabled to make a full and highly interesting tour of the very modern shops and plant installed there, with many quite recent improvements. The party was welcomed by Mr. J. Blakiston, foundry manager and senior vice-president of the visiting branch.

In view of the limited time of an afternoon visit to a large undertaking, Mr. Blakiston suggested that the visitors divide into parties according to the particular phase of the industry in which they might be interested, under guides more especially associated with such sections. The guides, in addition to Mr. Blakiston himself, were Mr. G. W. Nicholls, chief chemist; Mr. R. Oldershaw, chief foreman; Mr. R. L. Simpson, chief patternmaker; Mr. J. W. Mobbs, plaster former; and Miss Donovan, who dealt particularly with the costs and accountancy side of the industry. The arrangements had been ably carried out by Mr. S. W. Wise, hon. secretary of the branch, in consultation with Mr. Blakiston.

All present were much impressed by the company's research laboratories and the very thorough modernisation of every phase of the working plant. Mechanisation was seen to have been adopted in every possible direction, including automatic conveyor equipment in the moulding shop. Special interest was shown in a large vertical core-drying stove, in the method of charging and in the pneumatic jolting and mechanised turnover gear in the core shop. The oil-controlled Pneulec Hermann moulding machine for medium-weight castings takes boxes up to 6 ft. by 4 ft. An unusual feature so far as concerns foundry plants in Yorkshire was the exceptionally well-fitted moulders' washroom, installed with the very latest design of circular wash-basins; and the white-tiled ambulance room with every requirement in such a place, including sterilised hot water.

Assembling after the tour, the BRANCH-PRESIDENT (Mr. Turner), expressing thanks to the directors, to Mr. Blakiston and to the guides, said the party felt themselves under a deep debt of gratitude for being allowed to inspect so up-to-date an establishment and to see under working conditions so many excellent labour-saving devices which had been installed to supplement the shortage of skilled labour under existing conditions. Of special interest in such times as the present was the self-evident progress the company had made in utilisation of female labour in such operations as moulding, core-making, crane driving, fettling and general labouring.

MR. J. TIMBRELL (Junior Vice-President), seconding the thanks, said the visitors appreciated the way in which they had been allowed to make a complete tour without restriction, seeing the whole plant from the mixing of the sand to the fettling of the casting and including the accumulation and pouring of the metal in a mould for a very large casting of some 15 tons. They had been greatly impressed by all they had seen and, in his own case, particularly by the use of automatic conveyors and the up-to-date method of stoves and drying. One of the most outstanding features topical to the times was the company's extensive use of female labour.

MR. BLAKISTON, responding on behalf of the company, said the directors had determined to get the best they could out of the facilities available to the industry and to adapt their working methods to the needs of the time, with a thought also towards the future. All engaged in the undertaking were proud of their association with it and he (Mr. Blakiston) felt deeply gratified to the directors for allowing him the privilege of inviting his fellow members of the Institute to make the visit.

South Africa.—Mr. R. P. Stephens, of the Forest Products Institute, gave a very important lecture at the March meeting over which Mr. D. Lion-Cachet presided. He dealt with a number of recent investigations his Institute had made into emergency substitutes for the standard imported pattern timber. The position in South Africa is serious because the 70,000,000 cubic feet of soft timber imported in 1937 has been reduced by something of the order of 50,000,000 per annum. For hardwoods, the position is somewhat different and imports have now risen to 8 or 10,000,000 from a pre-war figure of 6,000,000 cubic feet. Shiploads of Obeche (Triplochiton Scleroxylon), which, it is stated, is very suitable for patternmaking, occasionally arrive from Nigeria and the Cameroons. Large quantities are said to have been shipped to the United Kingdom for this purpose. The lecturer dealt fully with the locally grown timber and its suitability for use in the patternshops, stressing how the individual site chosen for experiments had been found to have a profound influence on quality. The actual moisture content of seasoned timber for the Rand should be of the order 8 to 10 per cent., and his experiments showed much of the timber in use (limba, basswood, American poplar, and Parana pine) was insufficiently dried and as a result the surface had in some cases of over-exposure to sand contact picked up as much as 25 per cent.

A lengthy discussion followed in which the President, Mr. Mackay, Mr. Stones, Mr. West and Mr. Miller took part. Early in April the members visited the Forest Products Institute, where the lecturer was able to demonstrate the value of the research work in progress.

Maximum prices for aluminium sold by primary producers in pig-form have been set by the American Office of Price Administration at levels 1 cent. per lb. below prices of the corresponding ingots. The new maxima are in cents per lb. and apply to unalloyed grades sold on the basis of aluminium content and to certain rich alloys or hardeners. They range between 13 and 24 cents for unalloyed aluminium and from 14 to 16½ cents for alloys; subject to discounts, etc.

BASIC CUPOLA PROCESS FOR DESULPHURISATION

A new and important process which has passed successfully through the experimental stage to a full scale production unit

By E. S. RENSHAW

In the melting of metals in the cupola furnace, a considerable degree of control of composition can be obtained by careful mixing of available material and melting the mixtures under correct conditions of combustion. Each element can be held under control to meet rigid specifications, with perhaps the exception of sulphur, and only to a limited degree can technique be applied in normal cupola practice to control the extent of absorption of this element. Fortunately, in the grey iron field, the ill-effects of sulphur are not pronounced, when this element is balanced with the correct amount of manganese, but in the case of low-carbon irons, which require a high percentage of steel in the mixture, sulphur absorption becomes a more serious problem. In the melting of high-steel mixtures for duplex processes, such as in the production of malleable iron by the cupola/electric furnace process, or of steel by the cupola/converter process, the soda-ash treatment for desulphurising has to be applied.

It is interesting, in the first place, to consider the factors which determine the sulphur absorption. The percentage of sulphur in foundry coke ranges from 0.50 to 1.0 per cent., and is present in two forms, namely, sulphide sulphur, *i.e.*, CaS and FeS, and elementary sulphur. In the combustion of coke, the FeS and elementary sulphur are oxidised to form volatile sulphur dioxide, part of which may escape with the waste gases, or part may be taken up by the lime present in the charge, as follows:—

$$4CaO + 4SO_2 = 3CaSO_4 + CaS.$$

The calcium sulphate dissociates at temperatures in the region of 1,300 deg. C., according to the equation:

$$2CaSO_4 = 2CaO + 2SO_2 + O_2.$$

The sulphur absorbed by the iron is derived from the FeS by direct contact or similarly from the elementary sulphur. Another factor which is of great importance is the state of oxidation of the iron, the ferrous oxide thus formed being capable of releasing the sulphur of the calcium sulphide for absorption by the iron. This will be dealt with in detail later.

The sulphur is, therefore, distributed between the waste gas (as SO_2), the slag (in which it is present as CaS) and the metal (as ferrous or manganous sulphides). It becomes obvious, and, of course, is well known, that sufficient free lime must be present for any degree of desulphurisation to be effected. Cupola slag is formed by the fluxing of the coke ash (SiO_2 and Al_2O_3), sand (SiO_2) and fused lining (SiO_2, Al_2O_3), with limestone ($CaCO_3$) and the calcium silicate slag is of relatively low basicity with limited desulphurising properties. The basicity may be increased by further additions of limestone, but in the acid-lined cupola this is accompanied by an excessive erosion of the lining, and the basicity is thus not increased in proportion to the excess of limestone added. In considering the problem, therefore, it was decided that to reduce the acid-forming constituents in the cupola, it would necessitate lining the furnace with a basic refractory; thus the product of fusion from the furnace walls would be basic and possibly larger amounts of limestone could be added without effecting erosion of the refractory.

Choice of Basic Materials

In reviewing the basic refractory materials available for lining a cupola, it was decided to make the first choice dolomite, prepared in the form of "tarred basic," as commonly used in basic open-hearth and basic electric-furnace hearths and walls. Calcined dolomite, milled to a suitable grain size, was mixed with dehydrated tar to a ramming consistency, and the cupola was rammed with this mixture to a height extending 2 ft. above the top tuyeres. In the first run, this lining collapsed, the reason undoubtedly being due to insufficient time being allowed for sintering. It was, of course, realised that, assuming any original lining material to give reasonable resistance to fusion and erosion, a suitable patching or daubing material would be subsequently required to effect repairs, as in the case of an acid lining patched with ganister.

Tarred dolomite would be unsuitable for patching owing to its nature and lack of plasticity, it being essentially a ramming material. It was ultimately decided to prepare a monolithic lining, using a stable dolomite suitably prepared for ramming, and the requirements for patching would be fulfilled with a stable dolomite cement, which could be mixed with water to a patching consistency. A brief description of this material may be interesting to foundrymen who may not be familiar with refractories used in the basic-steel industry.

Stabilised Dolomite Cement

The mineral dolomite may be represented by the formula $CaCO_3$. $MgCO_3$, and for use as a basic refractory it is calcined at high temperatures to give magnesia and lime, represented by the following reaction:—

$$CaCO_3.MgCO_3 = MgO + CaO + 2CO_2$$

The magnesia after calcination is stable, but the lime hydrates readily on contact with the atmosphere and the material will perish after a few days' exposure. If such material containing water of hydration was used for the cupola walls, the water would subsequently be driven off and the solidity of the rammed material would be destroyed.

Basic Cupola Practice

In recent years, a successful method[1] of preventing this hydration has been evolved in which the lime fraction is converted to a stable tri-calcium silicate by calcining the dolomite with a pre-determined quantity of serpentine, or hydrated silicate of magnesium, the reaction being:—

$$6(CaCO_3.\ Mg\ CO_3) + 3MgO.2SiO_2\ 2H_2O = \underset{\text{Dolomite}}{} \quad \underset{\text{Serpentine}}{}$$
$$2(3CaO.SiO_2) + 9MgO + 2H_2O + 12CO_2$$

The product, known as stabilised dolomite clinker, is suitably ground and made into brick form or cement suitable for ramming or patching when mixed with water. A typical percentage analysis is as follows:—Silica, 14.44 per cent.; ferric oxide, 3.44; alumina, 1.50; lime, 40.04; magnesia, 40.30; and loss on ignition, 0.25 per cent.

Details of Experimental Cupola

The furnace chosen for the experimental lining was a standard type, capable of melting two tons of metal per hour, details of which are given in Table I.

The previous firebrick lining was knocked out to a height of 3 ft. 6 in. above the top tuyeres. Dolomite backing bricks, 9 in. by 4½ in. by 1 in., were placed

TABLE I.—*Details of Experimental Cupola*

External Dia.	Internal Dia.	Lining Thickness.	Top Tuyeres		Bottom Tuyeres	
			No.	Dimensions.	No.	Dimensions.
In.	In.	In.		In.		In.
36	27	4½	4	7 × 3	4	9 × 3

against the shell, followed by 3½ in. of rammed material, thus giving a lining thickness of 4½ in. Stabilised dolomite cement mixed with 6 per cent. water and 1 per cent. sodium silicate was rammed round a suitable former using pneumatic rammers and hard-wood blocks were used to form the tuyeres. The finished lining was first air-dried, followed by a gas flame, the temperature being gradually increased over a period of ten hours to about 400 deg. C., after which the surface of the refractory was hard and compact. For further repairs to the melting zone after each melt, patching cement prepared by grinding stabilised dolomite clinker to a finer grading than the ramming material, was used. This was milled with about 12 per cent. water in order to give it sufficient plasticity for application and must be applied immediately after mixing as the material possesses air-setting properties.

The experimental cupola was fitted with a continuous tapping box, through which both the slag and metal are passed and separated, and this was rammed with the same material. As the method of tapping has a certain bearing on the results obtained in the experiments, a brief description will be given. Fig. 1 shows the general arrangement and the principle consists of running both metal and slag through a single hole into the slagging box, which takes the form of a tea-pot spout ladle. As soon as tapping takes place, the iron fills the channels in the slagging box (B) and rises through the syphon (C) into the runner, where it flows into a tilting receiver. A short time after tapping and as slag (A) accumulates in the well, the slag and metal levels reach a state of balance as shown in Fig. 1, and remain such during the melt. The slag rises by virtue of its lower specific gravity along the upper slope, passing over the slag notch (D) at the side of the box, and as melting continues, the iron and slag run off quite automatically, the levels, which differ in each part of the system, remaining constant.

It will be seen, therefore, that the cupola well carries a relatively large volume of slag with a minimum quantity of metal, and the arrangement has proved to be very satisfactory in service. Air supply to the cupola was by means of a fan, the quantity being carefully calculated and recorded in pounds of air per minute by an air-by-weight recorder.

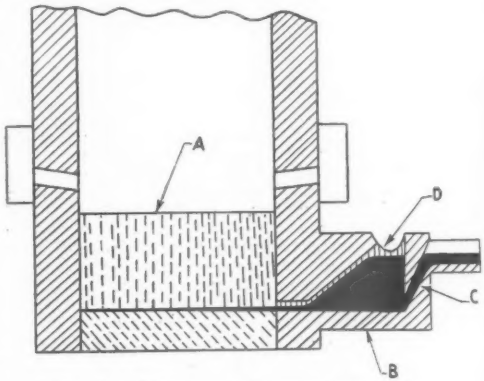

FIG. 1.—CONTINUOUS TAPPING ARRANGEMENT.

Experimental Melts

The same grade of coke was used for all the experimental melts, the analysis of which was as follows:—

Coke Composition: Ash, 9.5 per cent.; fixed carbon, 90.00; sulphur, 0.90; and volatile matter, 0.50 per cent.

Physical Properties: Shatter Index (2-in.) 81 and (1½-in.) 93; specific gravity (true), 1.88; and porosity, 50.0 per cent.

Coke Ash Analysis: Silica, 46.28 per cent.; ferric oxide, 12.80; alumina, 31.70; lime, 4.20; magnesia, 2.78; sulphur, 0.96; and phosphorus, 0.10 per cent.

In all melts the coke bed was 42 in. above the top tuyeres, carefully measured before charging commenced; and the flux consisted of limestone and fluorspar, the latter being added to give the basic slag sufficient fluidity to flow over the slag notch. The weight of metal in each charge was 500 lbs. and

the air supply set to give a melting rate of 3,500 lbs. per hr.

Several preliminary runs were carried out in order to observe the performance of the lining. No difficulties were apparent except an excessive erosion at the tap hole, where the constant flow of slag appeared to be giving penetration and ultimate collapse. Actually, it was found that when particular attention was paid to the ramming at this point, penetration was not excessive and in no way greater than in the acid cupola tap hole, in which case a mixture of finely-ground ganister and graphite is used.

The experimental melts were planned to cover mixtures suitable for grey-iron, high-duty irons, malleable iron and converter steel; thus the percentage of steel was progressively increased from 20 to 100 per cent. throughout the series. Table II gives the various mixtures and Table III the corresponding sulphur results.

TABLE II.—*Experimental Melts. Details of Charges.*

	Metal Charge.						Flux.		
Melt No.	Grey iron scrap. Per cent.	Malleable scrap. Per cent.	Pig iron. Per cent.	Steel scrap. Per cent.	Ferro-silicon. Per cent.	Ferro-Mn. Per cent.	Limestone	Fluorspar.	Coke ratio.
							Per cent. of metal charge.		
1	30	—	48	22	—	—	4	1	7 : 1
2	30	—	48	22	—	—	6	1	8 : 1
3	100	—	—	—	—	—	4	1	7 : 1
4	—	58	—	40	1.6	0.4	6	1	7 : 1
5	—	37.6	—	60	2.0	0.4	6	1	7 : 1
6	—	17.0	—	80	2.6	0.4	6	1	7 : 1
7	—	—	—	96.6	3.0	0.4	7	1	7 : 1

In the remaining melts, the steel was progressively increased to 100 per cent., plus ferro-manganese and ferro-silicon, and was representative of mixtures suitable for the production of low-carbon irons, malleable duplex metal and Tropenas steel. In each case, desulphurisation was obtained to limits which would obviate the necessity for after-treatment with soda ash.

It will be seen that in each melt, the first tap from the cupola gave a high sulphur figure and the reason for this is obvious, in so far as at this stage there is only a low volume of slag available in the well and the initial temperatures are below normal. This effect can be partly offset by making an addition of limestone to the coke bed. The effect of quantity of slag in the well was again instanced as in melt 4, when an increase in sulphur was apparent at samples 7, 8 and 9, which could be traced to an enlargement of the tap hole through erosion as mentioned previously. When this occurs, the slag level in the cupola

TABLE III.—*Experimental Melts. Sulphur Results.*

Samples taken each fifteen minutes (per cent. sulphur).

Melt No.	Per cent. sulphur in charge.	1st tap.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average sulphur.	Per cent. sulphur in acid cupola.
1	0.064	0.114	0.066	0.054	0.068	0.060	0.074	0.080	0.072	0.076	0.050	0.048	0.063	0.115
2	0.064	0.084	0.069	0.064	0.040	0.040	0.039	0.038	0.041	0.054	0.060	0.050	0.049	0.115
3	0.120	0.092	0.070	0.050	0.050	0.060	0.062	0.050	0.054	—	—	—	0.056	0.140
4	0.080	0.124	0.062	0.048	0.048	0.048	0.048	0.046	0.068	0.068	0.070	0.060	0.057	0.125
5	0.068	0.208	0.058	0.058	0.050	0.060	0.072	0.066	0.060	0.068	0.060	0.060	0.060	0.125
6	0.060	0.164	0.070	0.060	0.048	0.040	0.042	0.044	0.032	0.036	0.040	0.048	0.046	0.125
7	0.055	0.158	0.062	0.042	0.046	0.044	0.039	0.048	0.052	0.049	0.052	0.054	0.049	0.125

It will be seen that in the grey-iron charge suitable for cylinder blocks and representative of normal grey-iron analysis, not only was sulphur pick-up checked, but even reduced from the calculated amount in the charge. Using the same grade of coke and identical mixture in an acid cupola, the final sulphur would be 0.115 per cent., whereas the average sulphur over three hours in the basic cupola gave an average of 0.063 per cent. in melt 1 and 0.049 per cent. in melt 2. In the latter melt, an increase in the limestone added probably accounted for the lower sulphur figure. Melt 3 gave a closer indication of the possibilities of desulphurisation in the basic cupola. In this melt the charged material consisted solely of grey-iron scrap with an initial sulphur content of 0.12 per cent. and, as will be seen, this metal was desulphurised to give an average figure of 0.056 per cent.

Basic Cupola Practice

is automatically lowered and the volume of slag is correspondingly reduced. Observations on the type of slag produced were made during the course of the experiments and whereas the acid cupola slags, by virtue of their siliceous nature, are somewhat vitreous in appearance, the basic slag showed a distinct chalky appearance, particularly when desulphurisation was at its maximum. The colour generally varied from pale brown to dark brown, the former slag corresponding to low sulphur figures from the cupola and the latter to the higher figures. The only apparent difference between the two slags was in the FeO and MnO contents, and an increase from 0.50 to 1.50 per cent. of each of these constituents accounted for the change in colour, as also the desulphurising properties. By over-blowing the cupola, thus creating an oxidising condition, it was found that the sulphur would rise from 0.050 to 0.075 per cent., with a change in the colour of the slag to dark brown, a condition which was anticipated and will be discussed in detail later.

removal in the blast furnace in which the reducing action of carbon plays an important role. Reaction (2) represents sulphur removal in the basic open-hearth process. It is also accepted that high temperatures and slag fluidity are important factors, but as this reaction is reversible, the FeO content should be low and the available CaO high, *i.e.*, CaO in excess of that required to satisfy the acid constituents. In the basic electric furnace it is possible to obtain more exacting and favourable conditions. In this process, after dephosphorising, the oxidising slag is removed and a desulphurising and deoxidising slag made up of lime and fluorspar is formed and by nature of the electric method of heating, a reducing or neutral condition can be maintained in the furnace. Carbon added to the slag to form a carbide slag prevents sulphur reversal from the slag to the metal by removing the FeO.

Thus, for sulphur removal as CaS, certain conditions must exist, namely, sufficient available CaO must be present, *i.e.*, CaO in excess of that required to satisfy the acid constituents present and a minimum quantity of FeO to prevent a reversion of the sulphur.

Table IV gives typical analyses of slags capable

TABLE IV.—*Typical Percentage Slag Analysis.*

	Basic electric furnace.	Blast furnace.	Basic cupola (pale brown).	Basic cupola (dark brown).	Acid cupola.
SiO_2	18.4	33.82	30.8	29.80	45.2
FeO	0.4	0.20	0.52	1.47	4.8
CaO	61.26	47.24	44.04	45.15	30.3
MgO	7.27	2.03	14.0	12.90	1.0
Al_2O_3	5.95	15.71	8.74	6.46	15.0
S	1.30	1.73	1.08	1.00	0.5
MnO	0.44	1.30	0.83	1.43	1.5
CaC_2	0.46	—	—	—	—

As a result of these experiments, it was established that in a basic lined cupola the slag produced was capable of desulphurising the metal in the cupola because of its increased basicity (Table IV), and the extent of the desulphurisation not only depended on the quantity of base available but also on the oxide concentration. The factors in cupola operation, such as low bed height and unbalanced quantities of fuel and air, which give rise to an oxidising condition, are well known and should be avoided, as in all cupola practice.

Theoretical Considerations

In considering the removal of sulphur from molten iron by its conversion to a stable compound, CaS, insoluble in the metal and soluble in slag, it is interesting to compare conditions which exist for the reaction to be effective in pig-iron and steel manufacturing processes. The two following reactions should be considered:—

(1) $FeS + CaO + C = Fe + CaS + CO.$
(2) $FeS + CaO \rightleftharpoons FeO + CaS.$

Reaction (1) is usually accepted by the blast furnace authorities as the essential reaction for sulphur

of desulphurisation in the blast furnace and basic electric furnace, with basic and acid cupola slags for comparison. The similarity between the basic cupola slag and the desulphurising slag of the two other processes becomes very apparent, particularly in basicity ratio and FeO contents. The importance of iron oxide in limiting the desulphurising power of cupola slags has been noted by Trifinow,[3] who states that liquid iron can be sulphurised if in the oxidised state, or covered with a slag rich in FeO, it comes into contact with CaS, on condition that the ferrous oxide is "free," that is, not combined with an equivalent amount of lime. In this case, the following reaction takes place:—

$$CaS + 2FeO = CaO.FeO + FeS.$$

On the other hand, if free lime be present, the sulphur passes from the iron into the slag, according to the equation:—

$$FeS + 2CaO = CaO.FeO + CaS.$$

Abell,[4] in discussing sulphur pick-up in the acid-lined cupola, points out that by over-driving the furnace, *i.e.*, by using the minimum amount of fuel and the maximum amount of air, the greater is the quan-

tity of sulphur picked up by the iron, the solubility of calcium sulphide in molten slag being greatly reduced in the presence of oxides of iron.

Summarising the above remarks, in conjunction with the observations made in the basic cupola experiments, two points become clear. In a basic-lined cupola, a slag composition can be produced which is capable of desulphurisation by virtue of its basicity, but to obtain sulphur reduction to low limits, conditions of melting must be such as will avoid oxidation of the iron, otherwise the reaction is reversed according to the equation:—

$$FeS + CaO \rightleftharpoons CaS + FeO.$$

Conclusions

(1) In normal cupola practice, the slag-forming constituents are mainly of an acid nature; thus, the slag produced with the added flux is of low basicity. By substituting a basic lining for the usual acid refractory, the slag basicity can be increased and the properties of this type of slag are such that it offers the possibility of desulphurisation in the furnace.

(2) The results obtained in a series of experimental melts conducted in a basic-lined furnace have given sufficient justification for the deduction to be made that a basic cupola process is a practical proposition, and not only can sulphur pick-up be offset, but under suitable conditions of operation the metal can be desulphurised below the charged composition.

(3) Whilst slag basicity is an important factor in desulphurisation, certain conditions of furnace operation must exist in order to obtain the maximum effect, and further investigation is required to establish ideal conditions, as also the effect of operating temperatures, slag volume and viscosity.

Appendix

Since the above was written, the basic cupola process has been adopted on a full scale production unit, and the previous practice of desulphurisation with soda ash has become unnecessary. The cupola concerned is occupied in melting low carbon metal, which is run directly into an electric furnace for composition adjustment and super-heating, the latter furnace acting as a supply unit for a continuous moulding system. The furnace is being regularly operated to give metal with 50 per cent. lower sulphur content than was obtained in the acid furnace, and when required final figures of between 0.030 and 0.050 per cent. can be obtained by application of the principles outlined above.

Production Cupola Lining

The cupola has a lining thickness of 12 in., and the internal diameter is 36 in., with a normal melting rate of 9,500 lbs. of metal per hr. The continuous tapping system is employed, metal flowing continuously into the electric furnace, the inlet of which is at a distance of 4 ft. from the cupola tapping hole. The heat loss in transfer is thus reduced to a minimum.

Stabilised dolomite, prepared in the manner described above, was again used, and special precautions were taken during the ramming to allow for after expansion, which amounts to about 1.50 per cent. for this material. Expansion strips of wood were rammed in longitudinally with the material and spaced 2 ft. apart, the dimensions of the strips being 18 in. by 9 in., with a thickness of $\frac{1}{2}$ in. tapered to $\frac{1}{16}$ in., the tapered section pointing towards the shell. These strips were allowed to burn out during the preheating. No backing bricks were used for this lining, it being considered unnecessary, but the material was vented at the shell by using steel rods $\frac{1}{4}$ in. diameter, these being gradually raised as ramming proceeded. An alternate method is to use asbestos steam pipe lagging as a backing material, and a thickness of 1 in. against the shell is sufficient to accommodate the expansion. The basic lining was taken to a height of 4 ft. 6 in. above the top tuyeres, and at this height it has not been found essential to introduce a neutral refractory at the junction of the basic and acid materials.

Whilst over 3,000 tons of metal have been melted in the production cupola, it is considered too early to give an accurate refractory consumption figure for comparison with the acid lining. It may be stated, however, that the performance is very promising, and as more experience is gained in the application of stabilised dolomite, alone or in combination with other available basic refractories, some interesting results will be forthcoming.

The author wishes to acknowledge his indebtedness to the management of the Ford Motor Company, Limited, Dagenham, Essex, and Mr. A. R. Smith, Managing Director, for permission to carry out this work and publish the results. Also, Mr. J. V. Hartnett, Foundry Superintendent, and the author's colleagues, Mr. S. J. Sargood and Mr. T. Foley, for valuable assistance.

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[2] *Die Giesserei*, November 10, 1933.

[3] "Sulphur in the Cupola," Colin D. Abell. *Foundry Trade Journal*, October 8, 1940.

AMERICAN FOUNDRY LABOUR SHORTAGES

Serious labour problems are confronting American producers of all kinds of cast goods this summer. Both in ferrous and non-ferrous fields the problem of getting enough labour to man castings plants during the hot period threatens to become one of the most serious of the war. The type of labour used on the floors of foundries is that needed in virtually every war industry in the Cleveland area. Foundries have been forced to import much of their labour from States south of the Ohio River. These men, with few exceptions, cannot stand the heat of a foundry floor during the summer months. The same is true of negroes. The problem is not quite so serious in grey-iron castings fields as demand for this product either is about on an even keel or tapering off, in some cases, whereas the demand for non-ferrous castings is increasing rapidly.

CENTRIFUGALLY-CAST STEEL

(*Continued from page* 159)

friction rollers operating on roller bands near each end of the metal flask.

The molten steel from the electric furnace is conveyed to the weighing and pouring station by electric locomotive. The exact weight of metal to produce one casting is poured into an open-top pouring ladle, at the weighing station. The flask-mould combination is brought up to the proper spinning speed, about 1,100 r.p.m., and the metal is introduced by pouring from the ladle into a refractory trough terminating in a refractory orifice extended through the ring core stop-off into the mould. After slow cooling in the mould the castings are stripped, cleaned and inspected.

Tubes from 4 to 36 in. in dia. and from ½ to 4 in. in thickness, 16 ft. long, have been cast in sand-lined moulds by this method, and equipment is available to go up to outside diameters of 50 in.

Physical Properties

The physical properties of centrifugally cast steel have proved to be quite satisfactory. Some centrifugal jobs have been made at Birmingham, Alabama, where the specifications required tensile and bend tests to be cut from the casting itself. Tests for the ship shaft castings shown in Table I were made on specimens in this manner, and proved to be entirely satisfactory. The steel is a 0.30 per cent. carbon steel, with silicon and manganese somewhat higher than normal. Standard specimens cut from the 2½-in. thick shaft are required to meet the following specification:—Tensile strength, 40 tons per sq. in. max.; yield point, 17.8 min.; elongation, 20 per cent. min.; reduction in area, 30 per cent. min.; bend test, 120 deg.

For horizontal centrifugal casting in metal moulds the required tests on bogie wheel hubs (line 1, Table I) were made on bars cut from the castings. These were made of S.A.E. 1030 steel normalised and tempered and easily passed the following minimum requirements:—Tensile strength, 24.5 tons per sq. in.; yield point, 15.6 (standard 0.505 in. dia. tensile bar); elongation, 20 per cent.; reduction of area, 35 per cent.; bend test, 90 deg. on 1-in. by ½-in. bend bar.

For shapes adaptable to this method, horizontal centrifugal casting is an economical and efficient method for mass production of sound homogeneous steel castings.

As from April 1 the Doehler Die Casting Company reduced prices on castings of all types by 7 per cent. A previous reduction of 5 per cent. was made on July 1, 1942, on aluminium and magnesium die castings. The reduction in prices has been made possible by the present greatly increased output, plus various manufacturing economies recently put into effect. The company manufactures a long line of aluminium, zinc, brass and magnesium die castings, as well as permanent mould castings of aluminium and magnesium alloys.

PUBLICATIONS RECEIVED

Heat Penetration into Foundry Moulds. Published by the American Colloid Company, Chicago.

This very useful brochure, which has assembled the latest data on the subject, asks for criticisms and comment. The reviewer, who probably was the first to suggest experiments on the lines disclosed, now would like to have comparative heat transference data worked out for a large number of British moulding sands in order that a number of statements of a basic character could be formulated.

Facts About British Railways in Wartime. Published by the British Railways Press Office. Price 1s. net.

This booklet, which is now on sale at all the bookstalls, is the 11th annual edition, and takes on a new format in order to make it uniform with similar publications issued by the Fighting Services. In its older form, unillustrated and more sedate, it never reached the man-in-the-street in any great numbers, and enabled the reviewer to air his easily acquired erudition to schoolboy nephews. Now, with the advent of this more popular form, even overseas soldiers will assume the rôle of mentors to the young. It is an exceedingly interesting and well-worth-while publication, and the only suggestion the reviewer can make for the next issue would be to compare, for the benefit of those who are so keen on familiarising the *hoi polloi* with the "largest in the world," the size and activities of the largest British railway company as a unit with the world's biggest industrial undertakings, such as the American G.E.C. or Fords. The result would surprise some of our overseas visitors!

NEW CATALOGUES

Transformer Welding Equipment.—The General Electric Company, Limited, has prepared a booklet describing their single- and double-operator portable welding sets. In addition to some useful notes on the subject of welding, the booklet describes the construction and electrical characteristics of the sets, with useful information on their selection and operation. This subject is of considerable importance to-day and users of this equipment can obtain a copy of the booklet by applying to the G.E.C. through any of its branches.

Melting Furnaces.—In a 16-page well-illustrated catalogue received from Lees Hall & Sons, Limited, 113, Whitehouse Common Road, Sutton Coldfield, Warwickshire, there are descriptions of gas and oil bale-out furnaces; a very nice contraption for casting ingots, and which the reviewer suggests as being ideal for taking care of over metal in ironfoundries; tilting crucible furnaces using all types of fuel; and semi-rotary non-crucible furnaces. Additionally there are several interesting types of both oil and gas burners included. Two pages are devoted to performance data, some of which make attractive showing. It is understood that this publication is available to readers on writing to Sutton Coldfield.

CENTRIFUGALLY-CAST STEEL*

An Account of Practice at the Acipco Plant and Examples of Centrifugally-cast Products

By C. K. DONOHO (Metallurgist, American Cast Iron Pipe Company, Birmingham, Ala.)

The casting of metal in cylindrical moulds spinning about a horizontal axis has long been used in the mass production of cast-iron pressure pipe. Both the sand-lined mould and metal mould processes have been in successful commercial use for the past 20 years. The economic soundness of these two centrifugal processes for making cast-iron pipe has long since been proven. Consistently good physical properties are obtained by virtue of centrifugal casting, and this has resulted in a reduction in the required thickness and weight of pipe for a given service.

FIG. 1. — VERTICAL AXIS CENTRIFUGAL CASTING SHOWING ACTUAL PARABOLOIDAL CAVITY COMPARED WITH CALCULATED CAVITY.

Alloy steel gun barrels are centrifugally cast in horizontal metal moulds by a process developed over a long period of years at Watertown Arsenal. Tubular castings of various high alloy steels as well as non-ferrous metals are being produced in a number of foundries very successfully by horizontal centrifugal casting both in metal and in sand-lined moulds. Such parts as wheels and gears are cast centrifugally, but usually by spinning about a vertical axis. For several years there has been a gradual but continuous increase in the use of the centrifugal casting methods for producing high-quality castings, and the present emergency has given a sharp impetus to the centrifugal casting of steel, not only as an improvement on static casting methods for steel castings, but also as a method of producing directly from molten metal engineering parts of cast steel, which formerly could be made only from forgings, which involves the pouring of the ingot, passage through successive stages of the rolling mill, and finally the rough forming of the desired part.

All centrifugal casting is in effect pressure casting, in that the molten metal is forced against the mould wall under relatively high pressure, compared to the usual gravity head in static casting. This confers the advantages of better feeding, elimination of reduction of shrinkage cavities and gas pockets, and denser metal. Pressure as applied by centrifugal force differs from that applied by other pressure casting methods in that it is selective in its action, the heavier components being thrown outward with greater force than the lighter particles. This helps to eliminate light non-metallics by flotation inward toward the axis of the rotating moulds.

When a mould containing molten metal is spinning about any axis other than the horizontal, the resulting interior cavity is a paraboloid whose shape and dimensions depend upon: the spinning speed, the maximum

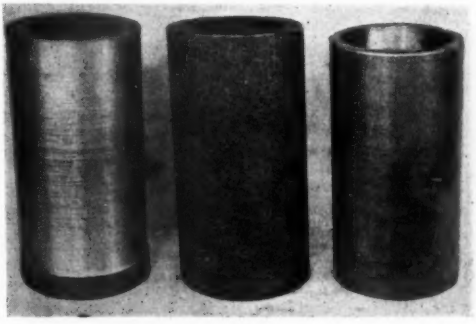

FIG. 2.—BOGIE WHEEL HUB CASTINGS—No. 1, TABLE I.

diameter at the top of the cavity, and the angle of inclination of the axis of revolution. When these three factors are known, the cavity—except as modified by shrinkage and piping—is exactly determined, and may be calculated by mathematical formulæ (Fig. 1). Centrifugal casting with axis vertical is commercially used for casting articles which are generally disc or wheel shaped with a hole in the centre. A section through the paraboloidal cavity at the axis of the casting carrying most of the shrinkage and non-metallic inclusions, is usually bored out in finishing. In another method of using centrifugal force about a vertical axis, moulds for several castings are spaced near the perimeter of the spinning flask. The metal is poured into a downgate at the axis and fed into the separate castings through radial gates.

* A Paper presented at the meeting of the Steel Founder's Society of America, Chicago, Ill., Feb. 10, 1943. –

Centrifugally-cast Steel

When a mould is spun about a horizontal axis the interior cavity formed by the molten metal is perfectly cylindrical, and is exactly determined by the mould dimensions and the volume of metal poured. This method is preferable for casting parts which are generally cylindrical in shape or at least cylindrical interiorly. In vertical centrifugal casting, pouring heads are often used to feed the metal into the axis of the spinning mould, and sometimes gates carry the metal from the axis to heavy sections along the perimeter. In horizontal centrifugal casting it is customary to pour a weighed amount of metal entirely into the mould itself so that yields of 90 per cent. or greater may be attained.

In making a casting with a cylindrical bore by the horizontal centrifugal method, the core for the inside is, of course, entirely eliminated, with attendant saving in time and labour. However, if more than one inside diameter is required, the larger I.D.'s may be formed by cores extending from the ends of the mould, leaving the smallest cylindrical I.D. to be formed by centrifugal force.

Advantages Shown

For true centrifugal castings, as produced by the horizontal method, inspection problems have been found to be greatly simplified. In static steel castings a large proportion of the critical defects are sub-surface imperfections, detectable only by radiographic or other expensive and time-consuming methods. In centrifugal castings such defects as are found are in nearly all cases at the inside or outside surface of the casting, and thus more readily detectable.

Briefly, the chief advantages of centrifugal steel castings are: sounder, denser, cleaner castings, higher yields, elimination of cores, and simplified inspection. The disadvantages are: the limitations as to sizes and shapes adaptable to the process, the expense of installing and maintaining spinning machines, the increased difficulty of changing equipment to make a variety of castings as in jobbing work.

The centrifugal process is best adapted to the mass production of large quantities of identical castings, and since this is also one of the conditions which make "permanent mould" processes economical, it is not surprising to find the two processes combined in many instances. The choice of the mould type, whether metal or sand, depends upon a number of factors which must be considered before tooling up to make a new type of casting. In general,

FIG. 3.—SHIP SHAFT CASTINGS—NO. 2, TABLE I.

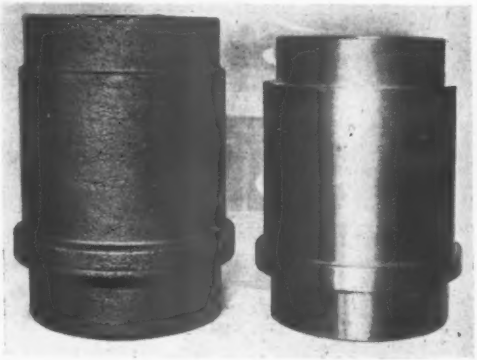

FIG. 5.—CYLINDER BARREL CASTINGS—NO. 5, TABLE I.

FIG. 4.—HAWSE PIPE-TUBES CAST CENTRIFUGALLY—NO. 4, TABLE I. FLANGES WELDED ON.

FIG. 6.—IDLER HUB CASTINGS—NO. 8, TABLE I. NOTE CORED LARGER I.D.'S.

the conditions favourable to the use of metal moulds are: (1) Where a very large quantity of identical castings are to be made; (2) where the outside contour of the casting is simple enough so that it can be readily slipped out of the mould, and (3) where a fast cooling rate from the outside inward, with attendant fine grain, is desirable. Centrifugal casting in sand-lined moulds is preferred: (1) Where the metal must flow relatively long distances over the mould surface; (2) where the shape of the casting is such that the mould must be broken down in order to remove the solid casting; (3) where it is essential to be able to vary the dimensions and shape of similar castings, and (4) where a relatively uniform cooling rate throughout a thick section is desirable.

Spinning Speeds

Spinning speeds for horizontal castings, of course, vary with the size and type of casting. For sand-lined moulds, a general rule is to use a spinning speed which will give a centrifugal force of about 75 times gravity. A simple formula derived from the centrifugal force formulæ to give the spinning speed for a centrifugal force of 75 lbs. per lb. of metal is:

$$N = \frac{1675}{\sqrt{R}}$$

Where: N = r.p.m. *e.g.* 6 in. dia. 967 r.p.m.
R = radius in inches 12 in. dia. 684 r.p.m.

Spinning speeds at or near the "favourable" r.p.m., as calculated by the above formula, have been found generally best, particularly for the initial spinning speed during pouring. Although a centrifugal force just sufficient to overcome gravity will theoretically hold the metal on the wall of the mould, the

FIG. 7.—WELD NECK CASTINGS—NO. 10, TABLE I.

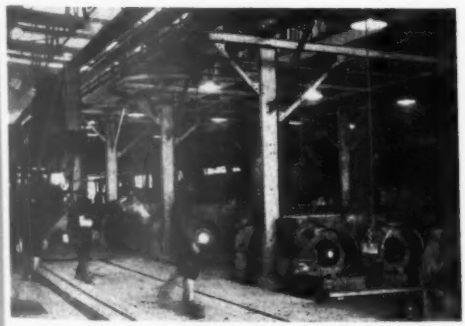

FIG. 8.—BATTERY OF 72 HORIZONTAL SPINNER HEADS FOR METAL MOULD CASTING OF CYLINDER BARRELS.

FIG. 9.—POURING THE WEIGHED AMOUNT OF STEEL INTO THE SPINNING MOULD.

FIG. 10.—EXTRACTING THE SOLIDIFIED CASTING.

Centrifugally-Cast Steel

higher force is desirable to squeeze out slag particles and lighter non-metallics. Also with speeds much less than the speed to give a force of 75 times gravity, the metal will not "pick up" readily without slipping or "raining." Excessively high spinning speeds will tend to cause longitudinal hot tears in the casting by reason of the circumferential tension developed by the centrifugal force, as the casting freezes and begins to shrink away from the mould wall.

In metal mould centrifugal casting, spinning speeds somewhat lower than the calculated may be used, since the chilling effect of the mould causes the metal to "pick up" more readily than in the refractory sand mould. For very thick castings, the initial spinning speed is often slightly increased above the calculated speed in order to quickly "pick up" the larger volume of metal. For castings, such as flanged castings, where the maximum O.D. is very much greater than the minimum I.D., the diameter on which to base the spinning speed calculation may be a compromise so as to have sufficient centrifugal force on the I.D. and yet not excessive force on the maximum O.D.

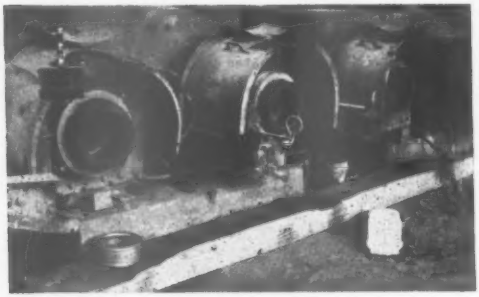

FIG. 11.—MOULDS READY FOR CLEANING AND REASSEMBLY.

Melting Plant Used

In the steelfoundry of the American Cast Iron Pipe Company a variety of steel castings is produced by centrifugal methods both in sand-lined and in metal moulds. While steel casting began there in 1940, centrifugal casting of grey cast-iron pressure pipe has been in production practice since 1922. As much as 15,000 tons of centrifugal castings per month has been the usual output for the past several years. The steelfoundry is served by five acid lined electric-arc furnaces, one of 2½-ton capacity, two 1½-ton capacity, one 1-ton capacity, and a 5-cwt. furnace used largely for experimental purposes. On a six-day (two-shift) basis, this foundry is capable of producing 1,500 tons per month of saleable product.

In the operation of the furnaces, preliminary carbon samples are ascertained in Leitz carbon meters, two instruments serving the five furnaces. Finished heats are tapped into teapot ladles, which serve as holding ladles and for pouring into the individual casting ladles. In analysis of final samples from each heat carbon, sulphur and phosphorus are determined in the chemical laboratory, while silicon, manganese and alloys are quantitatively determined by spectrographic analysis. In the spectrographic laboratory analysis for five elements is carried out in 20 minutes from the pouring of the sample, with an accuracy of plus or minus 2 per cent.

FIG. 12.—RAMMING 16 FT. LONG SAND MOULD FOR TUBULAR CASTINGS.

Type of Castings Produced

Figs. 2, 3, 4, 5, 6 and 7 show some of the castings regularly produced by the horizontal centrifugal method, and Table I gives the salient casting date. Bogie-wheel hub castings, cylinder barrel castings and other relatively short-length cylindrical steel parts are cast at the American Cast Iron Pipe Company's works in metal moulds spinning about the horizontal axis. The engine cylinder castings are usually made of S.A.E. 4140 steel, or some modification. They are normalised and tempered for softening, and then rough bored at the foundry to permit the essential inspection of the interior surface. Final machining, hardening of the bore, and finish grinding or honing are carried out by the engine manufacturers.

A furnace heat of about 4,000 lbs. is tapped from the furnace into the holding ladle at about 3,200 deg. F. This teapot ladle is transferred by the electric overhead travelling crane to a travelling floor crane which serves as the pouring and weighing car. This car moves back and forth on a track in front of the battery of centrifugal casting machines (Fig. 8). There are 18 spinning machines, having four casting heads each, making a total of 72 horizontal casting heads. Each metal mould is attached to a face plate mounted on a shaft. There is a mould at each end of each shaft, with two shafts, or four casting heads, driven by one variable-speed motor. A ring-shaped metal stop-off plate is keyed into the open end of each metal mould.

A dial scale is mounted on the pouring car and the metal poured into each hand ladle is carefully weighed to the pound. The pourers move the hand ladles suspended from an overhead trolley to the spinners and pour the entire contents through an orifice pouring trough into the spinning mould assembly (Fig. 9). Three four-head machines compose one unit with six heads on each side. The two pourers alternate at the pouring car and each pours six heads on one side of a unit before the car and pourers move on to the next unit. One unit of three machines with 12 heads is poured in about 3 min. The stripping and mould cleaning crew follow the pourers. The machines are shut down as soon as possible after casting, the stop-off plate removed, and the solidified casting immediately withdrawn (Fig. 10). The moulds are cleaned, loose particles blown out and the moulds faced and then reassembled (Fig. 11).

By the time all 72 moulds have been cast the pouring car is returned to the first casting unit, which is by that time ready to be recast. As of the present date, over 100,000 of these castings have been shipped to the fabricators.

Cylindrical Shafts and Tubing

Cylindrical shafts and tubing in lengths up to 16 ft. are made centrifugally by the American Cast Iron Pipe Company in horizontal sand-lined moulds. The moulding equipment and spinning machines used for this casting are those used for the production of Monocast centrifugal cast iron pipe in 16-ft. lengths. In ramming a mould, the metal flask is placed in a vertical position on a metal stool, which closes the lower end of the flask and centres the metal pattern inside the flask. The diameter of the metal pattern is the O.D. of the finished shaft, plus a shrinkage allowance and tolerance for finish in machining. Tempered synthetic sand is fed continuously from a cylindrical hopper into the upper end of the flask, and hand-guided pneumatic rammers pack the sand tightly between the pattern and the flask (Fig. 12). When the ramming of the 16-in. long cylindrical mould is complete, the flange part of the mould is rammed at the top and the pattern withdrawn upward.

The dimensions of the metal flask are such that the sand lining is always within limits of 1½ to 2 in. thick. The rammed mould is faced with a silica flour wash, then dried with gas. The mould is placed in the centrifugal casting machine, and the flange end closed with a flat core of baked oil sand on a metal plate keyed into the open end of the flask. The plain end of the mould is similarly closed with a ring-shaped core with a hole at the centre of the axis for introducing the metal. In the casting machine the flask is driven by two sets of separately powered

(*Concluded on page* 154)

TABLE I.—*Acipco Steel—Centrifugally Cast Castings made by Spinning about the Horizontal Axis.*

No.	Casting.	Max. O.D.	Min. I.D.	Total length.	Casting. Wt.-lb.	Steel type.	Mould type.	Pour time, sec.	Mould r.p.m.
1	Bogie wheel hub ..	5 in.	3⅜ in.	10 in.	30	S.A.E. 1030	Metal	9	950
2	Ship shaft	16-in. Flange 9-in. Body	4½ in.	16 ft.	2,500	S.A.E. 1030	Sand	90	1,100
3	Retort tubing ..	12¼ in.	10 in.	16 ft.	2,200	28–15 Stainless	Sand	90	700
4	Hawse pipe tubing ..	21.8 in.	20 in.	16 ft.	3,500	S.A.E. 1030	Sand	45	525
5	Cylinder barrel ..	7 in.	4¼ in.	9½ in.	40	S.A.E. 4140	Metal	11	975
6	Cylinder barrel ..	8⅜ in.	5½ in.	11⅜ in.	75	Nitralloy	Metal	15	900
7	Cylinder barrel ..	9 in.	5⅜ in.	12 in.	110	S.A.E. 4140	Metal	20	850
8	Idler hub	9 in.	5⅜ in.	9½ in.	62	S.A.E. 1030	Sand	12	800
9	Flanged weld neck ..	16-in. Flange	4 in.	11 in.	300	S.A.E. 1030	Sand	24	1,100
10	Flanged weld neck ..	11¾ in.	5 in.	13 in.	150	S.A.E. 1030	Sand	15	1,000

DISPOSAL OF SURPLUS IRON AND STEEL

Iron & Steel Disposals, Limited, has been registered as a private company with a capital of £1,000. Its objects are to adopt an agreement with the Ministry of Supply to acquire, stock and dispose of iron and steel in any form, and particularly surplus stocks. No dividend is to be paid or distribution of assets to be made prior to the winding up of the company. All profits and assets which would but for this provision be divisible among the members are to be handed to the Minister of Supply to be dealt with in accordance with the agreement mentioned above.

Formation of the company is explained by the fact that after four years of war there have been changes in the types of equipment required. Certain types have been superseded by others, leaving manufacturers with stocks of iron and steel products not now required. The purpose of the company, formed at the instance of the Ministry of Supply, is to enable such stocks to be acquired and redistributed for use for more essential purposes.

USES OF ZINC IN WARTIME

Relatively few people outside those directly concerned realised the important part which zinc, and particularly highly refined zinc, played in connection with the war effort, said Sir Colin Fraser, at the annual meeting in Melbourne of the Electrolytic Zinc Company of Australasia, Limited. It was one of the principal foundation stones upon which the munitions industry rested, he said. It had manifold uses in ordinary times under the headings brass-making, galvanising, rolled zinc, zinc die-casting alloys, zinc oxide, zinc sulphide, lithopone, zinc dust, etc. In wartime, every cartridge case and every projectile which left a gun called for zinc in one or other of its alloyed forms; as a constituent of brass or bronze it was also an important constructional material in defence equipment of all kinds; as an anti-corrosive or protective material it was used in galvanising and also in oxide form in paints and pigments. Zinc oxide was also an important constituent of motor and truck tyres. Zinc dust found a place in smoke mixtures and flares.

LICENCES FOR HIGH-SPEED STEEL

Until recently, only firms coming under the control of the Machine Tool Control have sent their high-speed steel licence applications to the Machine Tool Control for approval. As and from July 1, all firms wishing to acquire high-speed steel on Forms SC4/HT and SC4/LT should address their applications, and all correspondence appertaining thereto, to the Controller, Jigs, Tools and Gauges, Machine Tool Control, 35, Old Queen Street, London, S.W.1, and not to the Iron and Steel Control, Ashorne Hill, Leamington Spa, Warwick.

The Iron and Steel Control will continue to issue the licences after approval.

PERSONAL

MR. JOHN CAMERON has been co-opted a director of Federated Foundries, Limited.

MR. H. T. RICE has resigned from the board of the English Electric Company, Limited.

MR. E. L. WATTS has resigned from the board of the Steel Corporation of Bengal, Limited.

BRIG. H. P. CROSLAND, O.B.E., M.C., a director of Metal Traders, Limited, has been appointed C.B.E.

MR. SYDNEY BRYAN DONKIN has been elected chairman of the Association of Consulting Engineers for 1943-44.

MR. H. G. CHEEL has been appointed manager of the Union Works of the General Electric Company, Limited, in succession to Mr. J. A. Phelp, retired.

MR. CHARLES V. SALE, who has been ill for some weeks past, has resigned from the boards of the Amalgamated Metal Corporation, Limited, and its constituent companies.

MR. ANDREW WHYTE, managing director of Pease & Partners, Limited, has been appointed chairman of the company. Mr. William Buchanan will continue as vice-chairman and will combine this office with that of managing director.

Wills

HUGO, BARON HIRST, chairman of the General Electric Company, Limited	£498,650
SANDERS, T. H., of Leeds, director of Jonas Woodhead & Sons, Limited, Ibbotson Bros. & Company, Limited, and other companies	£11,201
SKELTON, J. H., chairman of H. J. Skelton & Company, Limited, engineers, iron and steel merchants, etc., London, E.C.2	£21,866

OBITUARY

MR. EDWIN JAMES BOWMAN, managing director of E. J. Bowman (Birmingham), Limited, manufacturers of motor radiators and sheet metal work, died recently.

MR. J. L. BUTLER, managing director of W. J. Jenkins & Company, Limited, gas and structural engineers, has died at his home at Retford, Notts, aged 53.

SIR HENRY MECHAN, chairman of Mechans, Limited, Scotstoun Ironworks, Glasgow, has died at the age of 87. Sir Henry entered his father's firm when he was a youth, becoming a partner and taking a prominent part in the development of the concern.

MR. FRANCIS GERMAN COWLRICK, head of the Continental department of Babcock & Wilcox, Limited, was a passenger in the air liner which was shot down recently while on a flight from Lisbon to the United Kingdom, and must be presumed to have lost his life.

MR. A. H. PUNTER has been killed in action while serving with the 16th/5th Lancers (Royal Armoured Corps) in North Africa. A partner in the firm of Paul Bloch & Company, he became a member of the Metal Exchange in 1937, and had been with the firm for 20 years.

STANTON DALE

Refined PIG IRON

for High Duty

Castings by Morris Motors Limited.

Casting by Baker Perkins Limited

Castings by Ruston Hornsby Limited

Castings by Ruston Hornsby Limited

Casting by David Brown & Sons (Hudd.) Ltd.

Casting by Oxford & Cowley Ironworks Ltd.

THE STANTON IRONWORKS COMPANY LIMITED
NEAR NOTTINGHAM.

NEWS IN BRIEF

WHOLESALE PRICES in May, as measured by the Board of Trade index number, showed a rise of 0.3 per cent. compared with April.

PURE METAL MANUFACTURING COMPANY, LIMITED, is being wound up under a members' voluntary winding-up. Mr. H. J. Penn is the liquidator.

GOODWIN ENGINEERING COMPANY, LIMITED, is being wound up voluntarily, with Mr. R. A. Harting, 14, Queen Victoria Street, London, E.C.4, as liquidator.

THE POST-WAR PLANNING COMMITTEE of the Institution of Electrical Engineers, in a report just issued, recommends the formation of a British Electrical Research Board.

THE DIRECTORS of the Whessoe Foundry & Engineering Company, Limited, have given £1,500 to set up and equip a pathological and bacteriological laboratory at Darlington Memorial Hospital.

IRON & STEEL INDUSTRIES OF INDIA, LIMITED, Mission Row Extension, Calcutta, has been registered in India as a public company. The capital is Rs. 15,00,000. Mr. R. K. Choudhury is named as director.

LIEUT. JAMES M'CLELLAND FERGUSSON, the Cameronians (Scottish Rifles), who has been awarded the M.B.E., is a partner in the firm of M'Clelland Fergusson & Company, gas engineers, West Regent Street, Glasgow.

MR. GEORGE HICKS, Parliamentary Secretary, Ministry of Works, speaking at a London salvage drive in London last week, said the Ministry had taken 580,000 tons of railings, and 400,000 tons had already been converted to war purposes.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS announce that Mr. L. St. G. Wilkinson, M.C., M.Sc., M.Inst.C.E., the borough engineer of Wallasey, is to be its new President. The Institution this month celebrates its 70th anniversary.

THE NATIONAL ARBITRATION TRIBUNAL has rejected a claim for the application to female workers employed on wire-rope manufacture by William Cooke & Company, Limited, Tinsley, Sheffield, of the recent advance in wages for female workers in the engineering industry.

THE DIRECTORS of Ferranti, Limited, electrical engineers, Hollinwood, Lancs, are seeking powers to increase their borrowing powers to a maximum of £3,000,000. The increased facilities will be used for the current requirements of the business and not in respect of items of the nature of capital expenditure.

A NEW ORDER issued by the Minister of Supply (S.R. & O., 1943, No. 816) prohibits, except under licence, the acquisition, disposal and consumption of animal glues and gelatines and fish glue in excess of the following quantities per quarter: Glues and gelatines, other than edible gelatine and fish glue, 6 tons; edible gelatine, 5 cwts.; fish glue, 3 cwts.

SIR WILLIAM JOWITT, Minister-without-Portfolio, who visited Cardiff recently to confer with members of the Welsh Advisory Council on Post-war Reconstruction, said he believed that a careful study of Welsh problems would reveal possibilities for the establishment of new industries, or new developments of old industries, which would revive the industrial life of Wales.

THE MAY ISSUE of the "Nickel Bulletin" includes a comprehensive abstract of a new Paper on the properties of nickel, a list of electrographic tests for the detection of various metals, and abstracts of recent work on the solubility of metals in mercury, effect of sulphur in furnace atmospheres, spot tests for zirconium and chromium and the value of boron additions to steel. Copies may be obtained, free of charge, on application to the Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1. Individuals are requested to give the name of the firm with whom they are employed or some other indication of their special interest.

THE NATIONAL ARBITRATION TRIBUNAL has awarded increased minimum rates to electric welders and burners in the Scottish steel foundry industry. The parties to the dispute were members of the Scottish Steel Founders' Association and members of the Associated Blacksmiths', Forge, and Smithy Workers' Society, who claimed payment of 2s. per hour. The Tribunal have awarded that the minimum rate for burners be 84s. 3d. per week of 47 hours, being the consolidated standard minimum rate for steel dressers, and that the minimum rate for electric welders be 88s. 2d. per week of 47 hours, being 1d. in excess of the consolidated standard minimum rate for steel dressers.

IN 1941-42, new products were manufactured by the Fullers' Earth Union, Limited, of Copyhold Works, Redstone Hill, Redhill, Surrey, from fullers' earth, known as Fulbond No. 1, 1A, 2, 3 and 3A. Fulbond No. 1 and No. 1A, which are calcium montmorillonites, are very similar to Southern bentonite, having low dry/green strength ratios; Fulbonds Nos. 2, 3 and 3A are all substantially sodium montmorillonites and therefore closely resemble Wyoming bentonite in their bonding characteristics, having high dry/green strength ratios. Any strength conditions that are required can be obtained by choosing the appropriate grade. New plant is now being installed to improve the qualities of these products.

IN 1942 THE ALUMINIUM COMPANY OF AMERICA and wholly-owned subsidiaries received a consolidated net income of $33,361,762, equal to $17.79 a share on the common stock. This compares with a net income of $40,882,134 for the preceding year, equal to $22.90 a share, representing a decrease of 18 per cent. Last year, the company produced over 50 per cent. more aluminium than in 1941. Of this production, 15 per cent. was from the government-owned Defense Plant Corporation plants built and operated by the company. All of such production plants are not yet completed and in operation; but when they are completed it is expected that the company's total capacity for producing aluminium will be approximately double the production of 1942.

CUPOLA LININGS

45" BALANCED BLAST CUPOLA

7 years 8 months in service

1,954 HEATS

34,449 TONS

IN JULY 1934 Glenboig supplied a complete lining for a 45in. Balanced Blast Cupola to John Lang & Sons, Ltd., Lathe Manufacturers. The cupola (which has a continuously running spout) has been operating five, six and sometimes seven days per week for nearly eight years. During that period a metal tonnage of 34,449 has been produced (the metal is used for high-grade machine tools) and not a single brick or split has been required throughout this long service. This example of Glenboig quality is quoted as evidence of uniformly consistent product. Remember, too, that there is a Glenboig firebrick for every firebrick requirement.

42/44% Al_2O_3 : **GLENBOIG SPECIAL · GLENBOIG SPECIAL CROWN**
36/38% Al_2O_3 : **GLENBOIG CROWN · GLENBOIG · CASTLECARY**
34/35% Al_2O_3 : **DYKEHEAD · GEM**

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GENERAL REFRACTORIES LTD.
GENEFAX HOUSE SHEFFIELD 10.

GLENBOIG

G.P. 82

COMPANY NEWS

(Figures for previous year in brackets.)

C. Lindley—Interim dividend of 10% (same).

Turner & Newall—Interim dividend of 3¼% (same).

Drake & Mount—Ordinary dividend of 5% (same).

Cannon Iron Foundries—Interim dividend of 5%.

R. Hood, Haggie & Son—Interim dividend of 5% (same).

G. Beaton & Son—Profit, £11,945 (£10,610); dividend of 10% and a bonus of 5% (same).

Ruston & Hornsby—Dividend of 12½% on the ordinary stock (same).

Union Steel Corporation (of South Africa)—Interim dividend of 3% (same).

N. Greening & Sons—Final ordinary dividend of 5%, making 7½% (same).

Whitehead Iron & Steel Company—Final dividend of 10%, making 20% (same).

Keith Blackman—Net profit for the year ended March 31, £149,601 (£118,167); dividend of 20% (same).

Tweedales & Smalley (1920)—Profit for year to April 30, 1943, £102,943; dividend of 17½% (15%); forward, £58,166 (£56,473).

Mason & Burns—Profit for the year to March 31 after depreciation, etc., £18,513 (£18,156); dividend of 20% (same); forward, £6,135 (£5,893).

Robert Stephenson & Hawthorns—Profit for 1942, £18,566 (£17,853); dividend of 5% (same); to general reserve, £5,000; forward, £3,830 (£4,014).

Beyer, Peacock—Dividend on the 5½% cumulative preferences hares for the half-year to December 31, 1936, and for the half-year to June 30, 1937.

Fullers' Earth Union—Net profit, after taxation, for the year ended March 31, £20,789 (£19,607); ordinary dividend of 15% (same); general reserve, £12,000; forward, £3,019 (£3,502).

Armstrong Stevens & Sons—Profit to March 31, after E.P.T., £25,267 (£25,017); income-tax, £14,000 (same); deferred repairs, £2,000 (nil); dividend of 17½%, £8,759 (same); forward, £13,514 (£13,006).

W. H. Baxter—Profit for the year to March 31 last, £4,187 (£4,028); dividend of 7% on the preference shares, £1,400; dividend of 10% on the ordinary shares, £3,000 (same); forward, £3,347 (£3,560).

Derbyshire Stone—Profit for 1942, after E.P.T., £73,450 (£69,671); balance after depreciation, income-tax, and war damage insurance, £40,026 (£43,551); ordinary dividend of 10% (same); forward, £56,823 (£49,812).

David Brown & Sons (Huddersfield)—Trading profit, after depreciation, £564,649 (£434,472); income-tax and E.P.T., £484,870 (£376,072); dividend of 10% on the ordinary shares (same); to reserve for contingencies, £100,000.

British Timken—Net profit for 1942, after charging depreciation, £117,097 (£108,924); taxation reserve, £63,000; contingencies, £20,000; dividend of 15% on the ordinary shares (same), £30,000; forward, £28,731 (£24,635).

Goodlass Wall & Lead Industries—Net trading profit for 1942, after E.P.T., £287,864 (£305,346); income-tax, £165,572 (£199,507); to staff pensions reserve, £10,000 (£5,000); ordinary dividend of 6% (same), with bonus of 1% (nil); forward, £82,076 (£80,023).

Electrical Apparatus Company—Net profit for the year to August 22, 1942, after provision for taxation, £15,245 (£13,427); preference dividends, £3,422; dividend of 15% on the ordinary shares; to general reserve, £5,500; forward, £21,860 (£20,085).

James Dunlop—A misprint in our issue of June 10 implied that the dividend on the preference shares of James Dunlop & Company, Limited, is in arrear as from December 31, 1931. Actually the preference dividend is paid up to December 31, 1941.

Plessey Company—Profit for the year to June 30, 1942, £221,702; income-tax, £138,000; to general reserve, £50,000; dividend on the 5½% cumulative preference shares, £6,875; dividend of 20% (same) on the ordinary shares, £25,000; forward, £38,099.

Baker Perkins—Net profit for the year ended December 29, 1942, after depreciation, income-tax, N.D.C. and E.P.T., £115,778 (£104,719); final dividend of 3½% on the ordinary stock, making 7% (same); to general reserve, £20,000; to pensions reserve, £2,500; forward, £110,175.

Peglers—Profit for the year to March 31, after E.P.T. and income-tax, £52,640 (£50,963); dividend on the preference shares, £2,145; to general reserve, £20,000; employees' bonus account, £4,000; pensions reserve, £5,000; dividend on the ordinary shares of 23½% (same); forward, £12,317 (£10,348).

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Valentine Engineering Company (Essex), 10, Broadway Parade, Billet Lane, Hornchurch, Essex—£1,000. A. F. and F. W. Watling.

Watson Slack & Company, 25, Montpelier Walk, London, S.W.7—Engineers and manufacturers' agents. £1,000. A. C. J. Hartley-Sharpe and S. E. Wright.

Almex Recovery & Refining Company—Metal merchants, dealers in scrap, etc. £5,000. P. Fisher, 44, West Kensington Court, London, W.14, subscriber.

E.M.F. Winding Company, Electromotive Works, 101, Villiers Road, London, N.W.2—Tool, pattern and machinery designers, engineers, etc. £3,000. H. H. Kalber.

Stanley James Engineering Company, Crown Works, 295, Commonside East, Mitcham, Surrey—£5,000. T. P. and L. T. P. Headland, S. F. and S. J. Argent, and S. Lewis.

Craftsmen (Alcester), Riverside Works, Alcester, Warwick—Engineers, tool makers, manufacturers of metal small wares, etc. £5,000. A. E. Skinner and C. F. Guillaume.

Callender-Suchy Developments, Hamilton House, Victoria Embankment, London, E.C.4—To take over the benefit of a process relating to depositing metallic films on non-conducting materials, and to enter into an agreement with C. T. Suchy & Callender's Cable & Construction Co., Ltd. £10,000.

MACNAB
MOULDING MACHINES

for High Production

LATEST ENCLOSED SAND PROTECTED JOLT SQUEEZE MOULDING MACHINE

SPECIAL FEATURES:

- MASSIVE YET SYMMETRICAL CONSTRUCTION.
- JOLT RAM—A REAL BLOW.
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- PATTERN DRAW—STEADY AND SMOOTH.
- AIR ON OIL CONTROL TO DRAW.
- MECHANISM SAND PROTECTED.
- PATENT AIR-LOADED DISC VALVES.

In the up-to-date foundry of a well-known ordnance factory large quantities of non-ferrous castings are produced for anti-aircraft guns.

MORE THAN 350 MACHINES OF THIS TYPE HAVE BEEN SUPPLIED.

ACCURACY is particularly important and Macnab Moulding Machines are used for all operations.

MACNAB Moulding Machines mean CLEAN, ACCURATE AND WELL FINISHED moulds—There are many sizes and types, suitable for economical production of varying classes of work. Full details will be sent on request. . . . . . .

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Raw Material Markets

IRON AND STEEL

Encouraging reports are to hand of the dimensions of the imports of Mediterranean ores which have already arrived in this country, and if this intake can be maintained it may be possible at no distant date to enlarge the make of hematite and low-phosphorus iron which is needed in the heavy engineering and machine-tool foundries. Limited tonnages of these grades are being released by the Pig-iron Control, but they fall short of requirements, and there is consequently an inflated demand for refined iron and steel scrap for foundry purposes. There is little change in the position of the light-foundry trade; some works are busier, but there is still much room for improvement generally.

Supplies of foundry coke continue to come forward, according to schedule, and the larger consumers mostly have quite considerable tonnages in stock. Buyers relying on regular deliveries of small parcels are also being catered for satisfactorily.

Shipbuilders' specifications, which are accorded special consideration, continue to absorb a very large proportion of the output of plates and sections, which has been considerably increased. Nevertheless, the heavy demand for boiler, tank and armour plates, as well as supplies for the locomotive shops, cannot be neglected, and it is difficult to place orders for delivery earlier than October next. Much shorter delivery dates are indicated for heavy joists and, although sheet makers still have plenty of work in hand, new business has not matured so rapidly of late.

Deliveries of iron and steel scrap material, on the whole, continue to keep pace with the demand. The chief call is for the heavier descriptions, which are less plentiful than the lighter grades. Demand from the steelworks remains at a high level, despite the fact that they provide a substantial proportion of their own needs. Foundrymen are getting all the scrap they require in most instances, although larger quantities of the heavier qualities could often be absorbed.

NON-FERROUS METALS

The system of control imposed upon the non-ferrous metal markets as a wartime measure was such as to cripple normal trading operations. While the absence of free markets is to be regretted, it is appreciated that as an emergency measure the drastic methods adopted have been largely justified. In fact, it can be said that the Non-ferrous Metals Control has functioned as efficiently as any controlling body. The primary duty of the authorities has been to ensure that consumers engaged on work of national importance receive sufficient metal to maintain uninterrupted operations, and in this direction they have done exceedingly well.

After meeting essential requirements there is little or no margin of supplies, so that ordinary domestic users cannot expect to receive much consideration. The need

(Continued at foot of next column.)

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"Z A N"—Stoves and heating apparatus. ZAN, LIMITED, Zan Works, Wheelock, Sandbach, Ches.

"METACON"—Metal containers. METAL CONTAINERS, LIMITED, 106, Edmund Street, Birmingham, 3.

"FRANK CALVERT" (Signature device)—Metals and alloys. FRANK CALVERT, 58, Roseville Road, Leeds, 8.

"ULTRIC"—Electric transformers, etc. ULTRA ELECTRIC, LIMITED, Western Avenue, Acton, London, W.3.

"DATIM"—Machine and hand tools. DAVIS & TIMMINS, LIMITED, Billet Road, Walthamstow, London, E.17.

"LINSYN"—Engine jointings and packings, etc. M. GIBSON, LIMITED, Africa House, Kingsway, London, W.C.2.

"GRENSON"—Wire brushes, etc. N. GREENING & SONS, LIMITED, Britannia Works, Bewsey Road, Warrington.

"LYCO"—Parting powder for foundry use. THOMAS E. GRAY & COMPANY, LIMITED, Granby Chambers, Gold Street, Kettering.

"CARBLOX"—Refractory bricks. THOMAS MARSHALL & COMPANY (LOXLEY), LIMITED, Storrs Bridge Works, Loxley, Sheffield.

TARGET device—Grinding wheels and grinding wheel segments. STACEY'S ABRASIVE WHEELS, LIMITED, 78, Artisan View, Sheffield, 8.

"LOCKER TITAN"—Vibrating screens and sieves. LOCKERS (ENGINEERS), LIMITED, Ellesmere Works, Church Street, Warrington.

"B & H (NOTTINGHAM), LIMITED"—Electrical switchgear apparatus. B. & H. (NOTTINGHAM), LIMITED, Popham Street, Nottingham.

"DURACLAD"—Insulating material and electric insulation parts. DURATUBE & WIRE, LIMITED, 16, Hanworth Road, Feltham, Middx.

"COLDAX"—Cementing or adhesive substances. W. CANNING & COMPANY, LIMITED, 133 to 137, Great Hampton Street, Birmingham, 18.

"METRALLOY"—Metal alloys. BROOKSIDE METAL COMPANY, LIMITED, Astra Works, Harland Estate, Honeypot Lane, Stanmore, Middx.

"GOAT BRAND" (Goat device)—Metal hollow-ware. WELSH TINPLATE & METAL STAMPING COMPANY, LIMITED, Cambrian Works, Llanelly.

"WEDCO"—Filter presses, sieves and sifters, and wire conveyor belts. BRITISH WEDGE WIRE COMPANY, LIMITED, Academy Street, Warrington.

"STRENGTH, SIMPLICITY, SAFETY" (Triangular device)—Metal scaffolding. STEEL SCAFFOLDING COMPANY, LIMITED, 23, Oatlands Drive, Weybridge, Surrey.

(Continued from previous column.)

for conserving shipping is a vital factor in the metal situation and if it were possible to allocate more shipping space for the purpose, much larger quantities could undoubtedly be brought over. Meantime every economy will continue to be practised.

TRADE SIROCCO MARK

FANS for FOUNDRIES

THE comparatively high pressures which are necessary in connection with the supply of air blast to forges and cupolas, or work of a similar character, requires the employment of a Fan possessing an exceptionally high standard of performance and operating efficiency. Such strenuous demands are adequately fulfilled by

"SIROCCO" HIGH-PRESSURE FANS

which are soundly constructed to give hard and continuous service with a minimum of attention. "Sirocco" Fans are manufactured in four different types, i.e., Cast-Iron High-Pressure, Single Inlet Cupola, Double Inlet Cupola, and Narrow-Pressure Fans.

Publication Ref. No. SF26, describing "Sirocco" H.P. Fans, is available on request.

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Whether Oil, Cream or Compound, the high efficiency gives better permeability, quicker drying, accurate cores, low objectionable gas content, and therefore, faster and cheaper production.

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Telegrams: **"Sternoline, Phone London"**

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, June 23, 1943

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.)

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

(Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.)

Ferro-silicon (5-ton lots): 25 per cent., £21 5s.; 45 per cent., £23 10s.; 75 per cent., £36 10s.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £44; max. 2 per cent. C, 1s. 0½d. lb.; max. 1 per cent. C, 1s. 1½d. lb.; max. 0.5 per cent. C, 1s. 1½d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 5d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s. 6d.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s., joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ½ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t. 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 10s.

Tin.—99 to under 99.75 per cent., £275; 99.75 to under 99.9 per cent., £276 10s.; min. 99.9 per cent., £278 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11¾d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10¾d.; wire, 10¾d.; rolled metal, 10¼d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 13¾d. per lb.; sheets to 10 w.g., 14¾d.; wire, 16d.; rods, 16d.; tubes, 21¼d.; castings, 19d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 15 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5¼d. to 1s. 11¼d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6¼d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9¼d. Wire round, to 10g., 1s. 7¼d. to 2s. 2¼d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6¼d. upwards.

NON-FERROUS SCRAP

Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s., braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ¼ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £74 10s., all per ton ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended June 19, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

BRASS.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

CUPRO NICKEL.—80/20 cupro-nickel webbing, £75 10s.; 80/20 defective cups and envelopes before filling, £70 10s.

NICKEL SILVER.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

COPPER.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d. heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(NOTE.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*

WILLIAM JACKS & COMPANY LIMITED
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

PIG IRON

All grades FOUNDRY, HEMATITE SPECIALS, FERROSILICON, &c.

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COPPER, TIN, LEAD, SPELTER, BRASS, GUNMETAL

WILLIAM JACKS & COMPANY LIMITED

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2

13 RUMFORD STREET, LIVERPOOL.

NOTICE

Small Advertisements in this section of the Journal are accepted at the *prepaid* rate of 2d. per word in ordinary type and 3d. per word in capitals.

Minimum charge for one insertion 4/-.

Instructions for these advertisements, accompanied by a remittance, are accepted up to FIRST POST WEDNESDAY MORNING for insertion in the current week's issue. All communications to be addressed to the Advertisement Manager, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe, Bucks. The Proprietors reserve the right to refuse any advertisement they consider unsuitable.

SITUATIONS WANTED

FOUNDRY MANAGER (37), M.I.B.F., desires change, with post-war prospects; handling approx. 300 male and female; competent; metals, general engineering, all types pump and compressor castings; sound knowledge moulding machines and modern production methods.—Box 878, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

M.I.B.F. (46), accustomed to complete control, production and commercial, wishes to contact principals who need the services of a Works Manager, with many years' executive experience; used to mechanised methods; pressure-tight castings; metals to 21 T.T.; machine shop practice; mixed labour; costing and office organisation; free at any time for any district.—Box 908, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY MANAGER, M.I.B.F. (41); practical and thoroughly experienced estimating, planning and ratefixing; grey, heavy engineering castings up to 35 tons, in green, dry sand and loam; full mechanisation light repetition; modern plant; take full control; free end June.—Box 910, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

PRACTICAL Iron Foundry Foreman desires change; over 20 years' experience as Head Foreman; highest references.—Box 882, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

EMPLOYMENT REGISTER.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

FOUNDRY WORKS MANAGER; 17 years' executive experience, machine tools and internal combustion engines; estimating, costing and organisation; casting of mechanised plants; age 45. (449)

AGENCIES

POST-WAR SALES.—Young Man, with large experience in light foundries, patternmaking, manufacturing and selling, wishes contact Foundry (not necessarily light foundry); willing prepare for post-war trade; agency and advisory capacity.—Box 906, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

AGENCIES—*contd.*

AGENCY.—Advertiser, with excellent connections Non-Ferrous Foundries, Birmingham area, open to represent an additional first-class firm; own office and car.—Box 906, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MACHINERY

WANTED.—100 ft. Gravity Roller Conveyor; about 16 in. wide.—"WARWILL," LTD., Abertillery.

WANTED.—Pig-Breaking Machine; electric or hydraulic.—Particulars to G. & R. THOMAS, LTD., Hatherton Blast Furnaces, Bloxwich, Staffs.

WANTED.—Parkes or similar Testing Plant, with or without Compressor—Box 904, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MISCELLANEOUS.

Standard Size Adaptable Moulding Machines, etc.
"Ajax" No. 9 Macdonald Pneumatic Jolter turnover table, 36 in. by 46 in.
Coal and Coke Crusher; 2 ft. 6 in. dia.
Brealey Type Sand Disintegrator.
Macnab 5 ft. 6 in. Sand Mills, Size No. 2, with or without 3/50/400 v. motor.
Core-Drying Stove; 6 ft. by 6 ft. by 3 ft.
Broadbent Brick Crusher.
Sandblasting Plant; 50 Air Compressors; 500 Electric Motors, Dynamos, etc.

S. C. BILSBY,
CROSSWELLS ROAD, LANGLEY,
NR. BIRMINGHAM.
Broadwell 1359.

FOR SALE.—One Junior Motive Type Sandslinger; built by the Foundry Plant & Machinery, Limited; very little used; travelling type, with 7 tons sand bin with 12 ft. radius arm; the machine is complete and in first-class condition; can be seen by appointment.—SIR JAMES FARMER NORTON & Co., LTD., Adelphi Iron Works, Salford, 3.

THOS. W. WARD LTD.

Two direct-tube MARINE TYPE BOILERS; 14 ft. by 8 ft. 6 in.; w.p. 100 lbs.
LOCO BOILER; 9 ft. 7 in. overall; barrel 5 ft. by 2 ft. 3 in.; w.p. 160 lbs.
VERTICAL BOILER; 6 ft. by 2 ft. 6 in. by 80 lbs. w.p.
LANCASHIRE BOILER; 30 ft. by 7 ft. 6 in. by 180 lbs. w.p.
LANCASHIRE BOILER; 30 ft. by 8 ft. by 120 lbs. w.p.
Two LANCASHIRE BOILERS; 30 ft. by 8 ft. by 160 lbs. w.p.
Two LANCASHIRE BOILERS; 30 ft. by 9 ft. by 160 lbs. w.p.
Good secondhand ANGLES, comprising 2 in. by 1 in., 3½ in. by 2½ in., 4 in. by 2½ in., 4 in. by 3 in., 5 in. by 3 in., 5 in. by 5 in. sections; random lengths.
Good secondhand M.S. TEES; 3 in. by 2 in. and 4 in. by 4 in. sections; random lengths.

Keen prices. Prompt delivery.

Write for "Albion" Catalogue.

ALBION WORKS, SHEFFIELD.
'Grams: "Forward." 'Phone: 24311 (15 lines).

MACHINERY—*contd.*

2 "ACME" Sand-Drying Stoves, for coke firing; 2 ft. 4 in. long by 2 ft. 6 in. wide by 3 ft. 6 in. high.—Apply: NEWMAN, HENDER & Co., LTD., Woodchester, Glos.

MISCELLANEOUS

CAPACITY AVAILABLE FOR SMALL MANGANESE BRONZE CASTINGS. PROMPT DELIVERIES.—SEND YOUR ENQUIRIES TO WARWILL, LTD., ABERTILLERY, MON. 'PHONE 71.

GOOD Grey Iron Foundry in West Riding of Yorkshire has capacity for two to three tons per week of repetition Castings, from a few ounces to 1 cwt. each. Good quality castings and prompt deliveries assured.—Apply Box 5.0, FOUNDRY TRADE JOURNAL, 3, Amersham ROAD, High Wycombe.

MIDLAND FOUNDRY open to accept Orders for Castings up to 30 cwts.; plain or machined; green, dry sand, or loam. Good deliveries.—Box 902, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MOULDING BOARDS and other Foundry Requirements in wood.—Immediate delivery from W. J. HOOKER, 73, Cotswold Gardens, London, N.W.2. Gladstone 3474.

FOR SALE.—Four Tons Wire; suitable for core making.—PORRITT, Mayfield, Leeds Road, Mirfield. Tel.: 3218.

FOR IMMEDIATE DELIVERY TO IRON & STEEL FOUNDRIES SEND TO:—

JOHN & C. DURRANS,
Est. 1934,
PENNINE WORKS, HAZLEHEAD, NEAR SHEFFIELD.
Penistone 128. Facings, Penistone

FOR
Blacking, Plumbago (Ceylon), Core Gum Part Powder, Facings, White Dust, Terra Flake, Talc, Ganister, and ALL Foundry Requisites.
Send P.C. for price and samples.
Good stocks kept.

PATTERNS for all branches of Engineering, for Hand or Machine Moulding.—FURMSTON & LAWLOR, Letchworth.

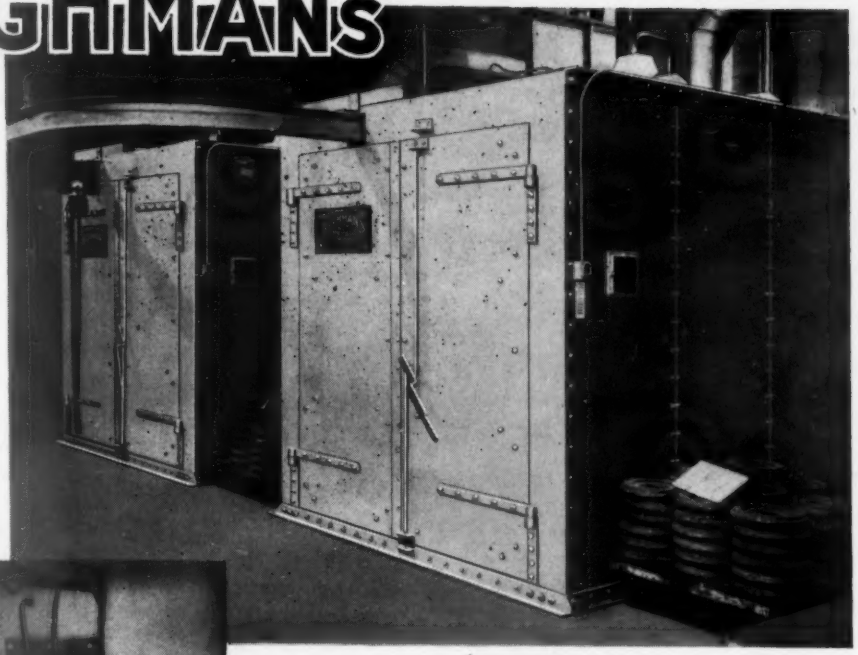
'Phone: 22877 SLOUGH

Air Compressors, all sizes.
Electric Motors, all sizes.
Ladles, all sizes.
4' 6" Cupola by Pneulec as new.
6' 6" Cupola by Green as new.
Greens cupolette with electric fan.
New 4ft. sandmill.

NEW SHOT BLAST CABINET PLANTS with motor driven Exhaust Fans, complete, all sizes; air compressors to suit in stock, also motors if required.

Alex. Hammond, *Foundry Machinery Merchant.*
14 AUSTRALIA Rd. SLOUGH
BUY FROM ME AND SAVE MONEY

TILGHMANS



SHOT BLAST ROOMS

These blast cleaning rooms are fed by an overhead conveyor, pulley block and tackle. Many different types of castings and forgings can be dealt with—much larger than those shown can be cleaned with equal efficiency. The shot falls through the perforated floor to be re-used, while dust is exhausted to a Dust Arrester seen in the background. Write for details of this and other types of abrasive cleaning plant.

TILGHMAN'S PATENT SAND BLAST CO. LTD.

17, Grosvenor Gardens, London, S.W.1 53

FOUNDRY TRADE JOURNAL

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FOR ALL PURPOSES

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